

# GLOBE Aerosol Field Campaign – U.S. Pilot Study 2016



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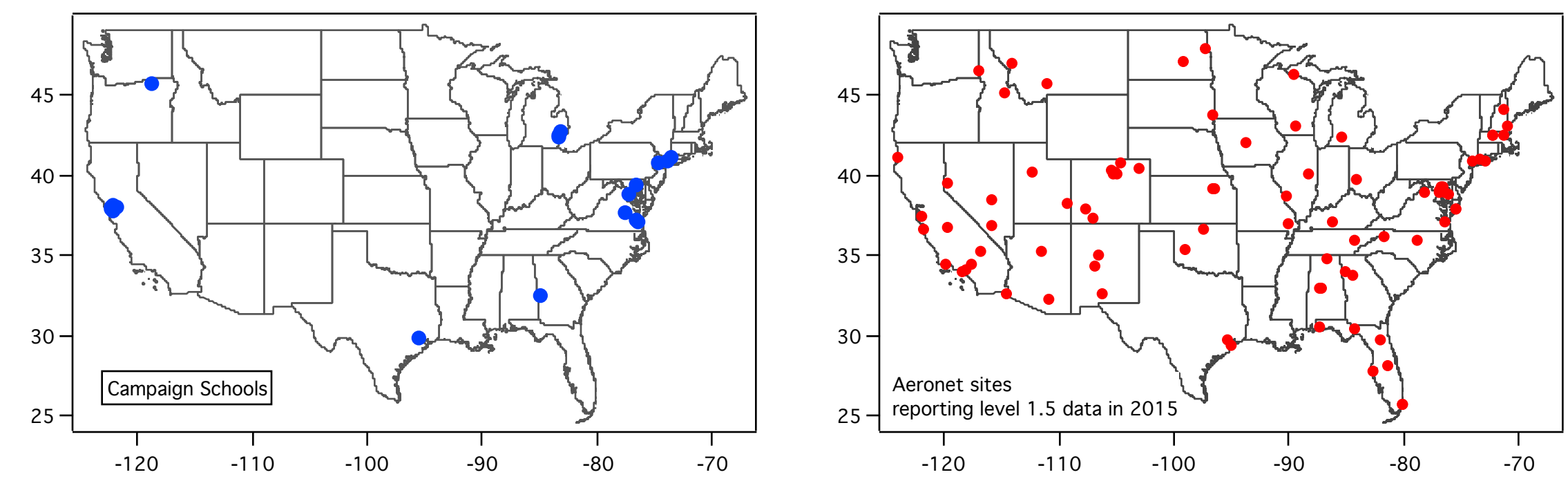
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## Participating Schools

During the spring of 2016, from April 4 – May 27, sixteen GLOBE schools participated in the GLOBE Aerosol Field Campaign – U.S. Pilot Study. Thirteen teachers from these schools had previously participated in the NASA LEARN program (Long-term Experience in Authentic Research with NASA) where they were GLOBE trained in Atmosphere protocols, and engaged in 1-3 years of research under the mentorship of NASA scientists. Each school was loaned two aerosol instruments for the Campaign duration, either 2 GLOBE sun photometers, 2 Calitoo sun photometers, or 1 of each. This allowed for students to make measurements side-by-side and in the case of the Calitoos, to compare AOT results immediately with each other for better consistency in data collection. Additionally, as part of the Field Campaign evaluation, multiple instruments allow for an assessment of the ease of use of each instrument for grade level of students, whether in middle school or high school. Before the Campaign, all GLOBE and Calitoo instruments were 'checked out' against an AERONET, then checked again upon return after the Campaign. By examining all data, before, during and after the Campaign, this gives an indication of instrument performance and proficiency obtained by the students. Support was provided to each teacher and their students at the level requested, via email, phone or video conferencing.



Participating High Schools							
School Name and Location	GLOBE Teacher	School Site		PM 2.5 Site		AERONET Site	
		Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
Stamford High School, Stamford, CT	Sue Dougherty	41.062	-73.5321	41.1714	-73.1953		
Stoney Creek High School, Rochester Hills, MI	Eric Thuma	42.6999	-83.1223	42.4308	-83.0008		
Wylie E Groves High School, Beverly Hills, MI	Chris Marentette	42.5177	-83.2446	42.4308	-83.0008		
Crestwood High School, Dearborn Heights, MI	Diana Johns	42.3217	-83.2935	42.3075	-83.15		
Pan American International At Monroe, Bronx, NY	Samantha Adams	40.8321	-73.8777	40.8147	-73.8867		
Northbrook High School, Houston, TX	Robert Bujosa	29.817	-95.5305	29.9011	-95.3261	29.3877	-95.0427
WT Woodson, Fairfax, VA	Ellen Babcock	38.8402	-77.276	38.7717	-77.1089		
York High School, Yorktown, VA	Alicia Dobyns	37.204	-76.5005	37.1037	-76.3869	37.105	-76.3788
Participating Middle Schools							
School Name and Location	GLOBE Teacher	School Site		PM 2.5 Site		AERONET Site	
		Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
Arnold Magnet Academy, Columbus, GA	Melissa Niemi	32.5144	-84.9632	32.5214	-84.9436		
Waldorf School of Baltimore, Baltimore, MD	Kathleen Breen	39.347	-76.6544	39.41	-76.2967	39.2826	-76.6169
Mountain View School, Mendham, NJ	Denise Magnini	40.7747	-74.599	40.5153	-74.8068		
Sunridge Middle School, Pendleton, OR	Jodie Hamden	45.6506	-118.7871	45.6522	-118.823		
Our Lady of Mount Carmel School, Newport News, VA	Angie Rizzi	37.0524	-76.4725	37.1037	-76.3869	37.105	-76.3788
Moody Middle School, Henrico, VA	Jackie Calder	37.6248	-77.4823	37.10367	-76.3869	37.105	-76.3788
Participating GLOBE Schools in conjunction with GLOBE Partner Dr. Mike Jabot							
School Name and Location	GLOBE Teacher	School Site		PM 2.5 Site		AERONET Site	
		Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
Fredonia Central, Fredonia, NY	Amy Lauer	42.4537	-79.3367	42.9981	-78.8993		
Cassadaga Valley Central Schools, Sinclairville, NY	Sandi Askin	42.2551	-79.2837	42.9981	-78.8993		



EPA PM<sub>2.5</sub> monitoring sites



The majority of the participating schools are located along the east coast, with many located near AERONET and/or PM<sub>2.5</sub> monitoring sites.

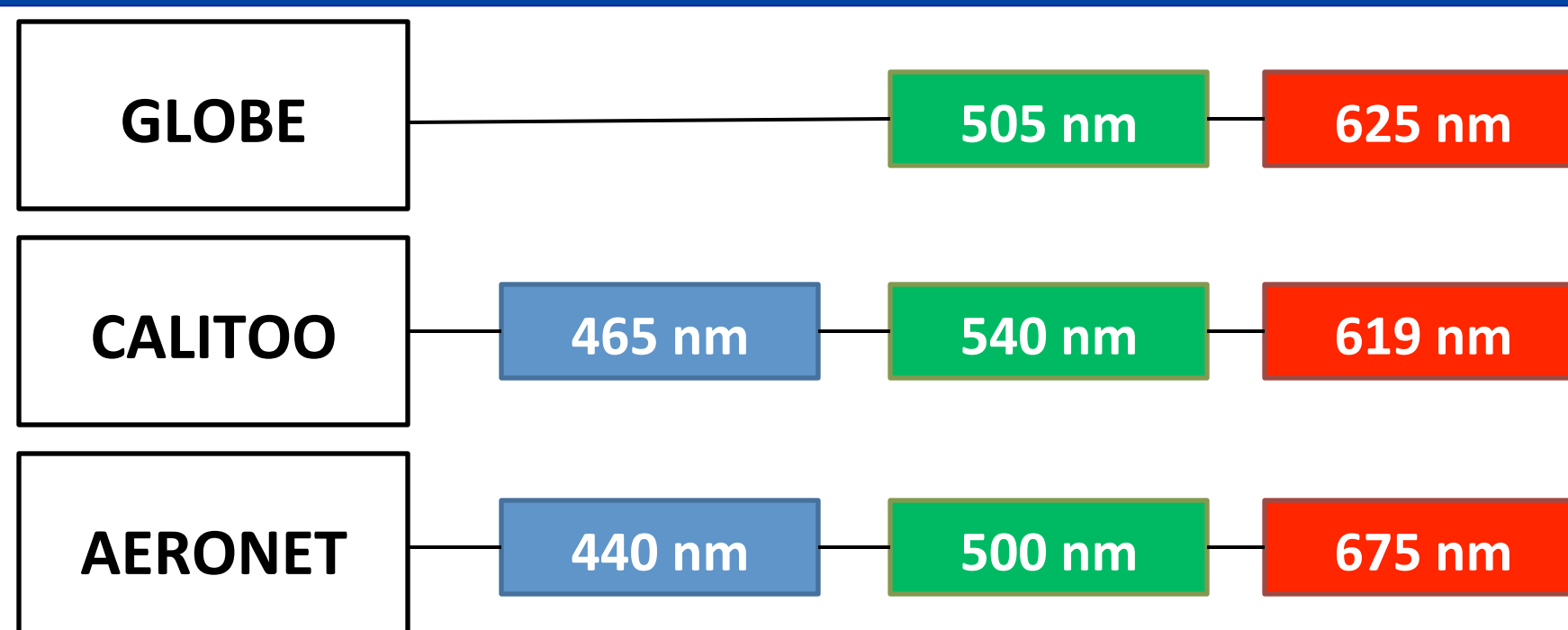
## GLOBE Instruments



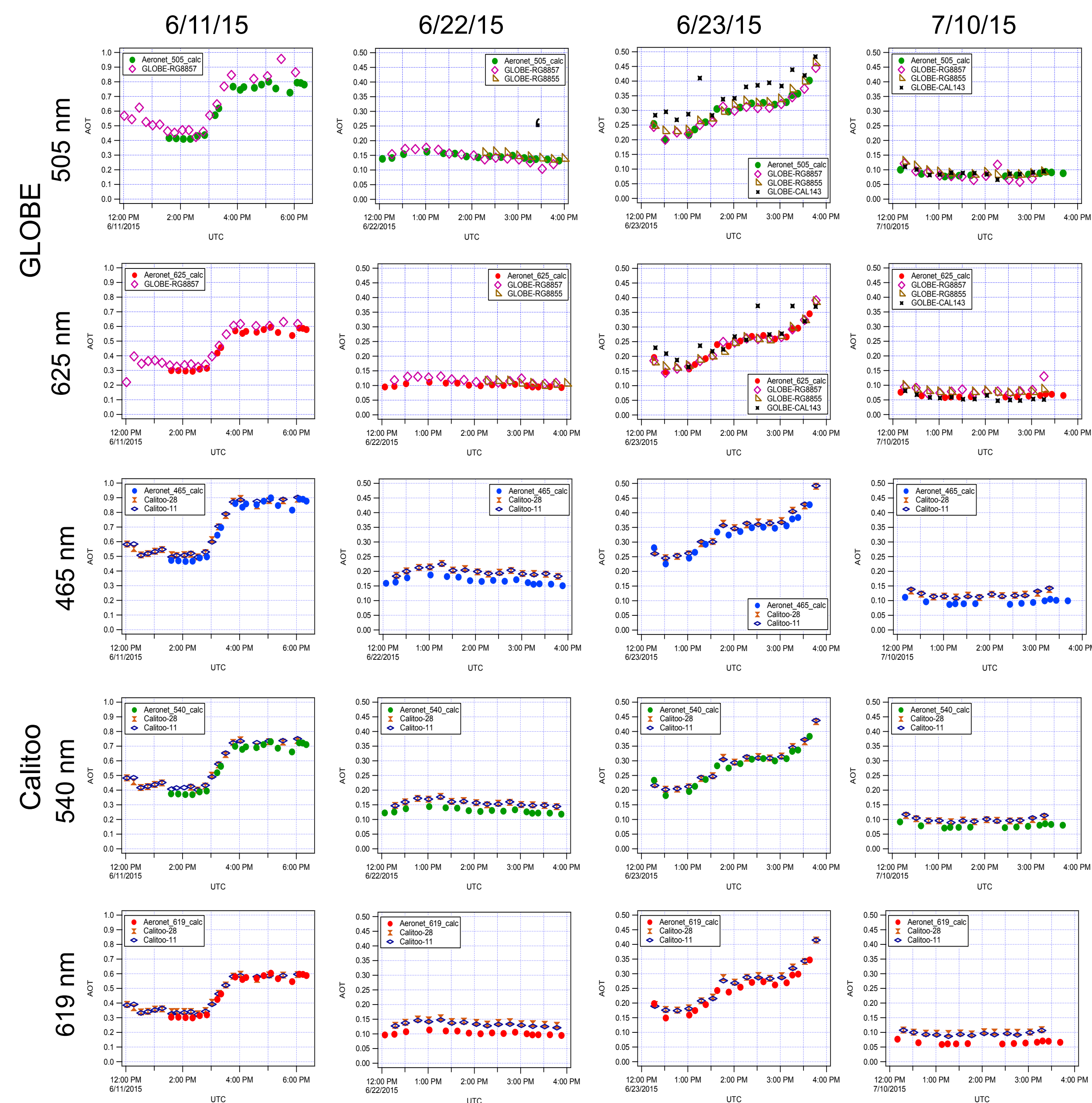
GLOBE Sun Photometer



Calitoo Sun Photometer



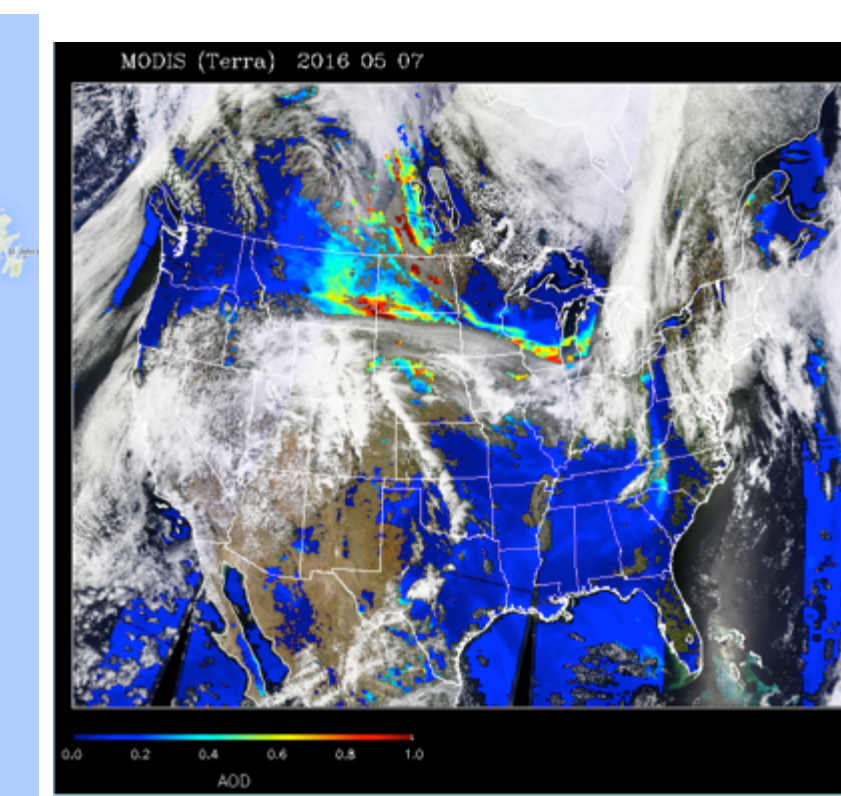
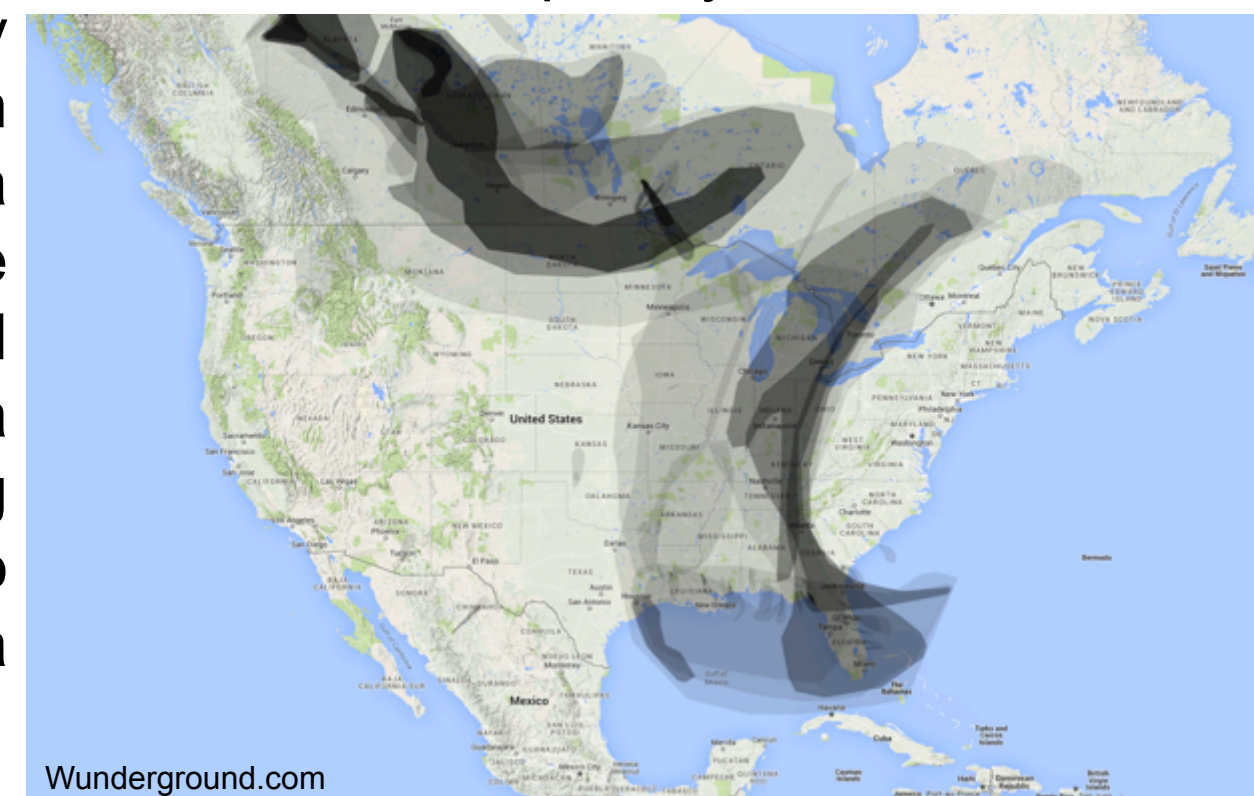
Measurements taken by students using the GLOBE and Calitoo sun photometers can be used to accurately measure aerosol concentration after a two or three day familiarization period. Both photometers demonstrate consistency over all wavelengths, allowing for the detection of various sizes of aerosol. The instruments have been compared with AERONET (Aerosol RObotic NETwork) AOT at the NASA Langley Chemistry and Physics Atmospheric Boundary Layer Experiment (CAPABLE) site in Hampton, Virginia. Over the four days shown below, which display a range of AOT of approximately .09 to 0.9, both instruments were able to measure the same trend as AERONET across all five wavelengths.



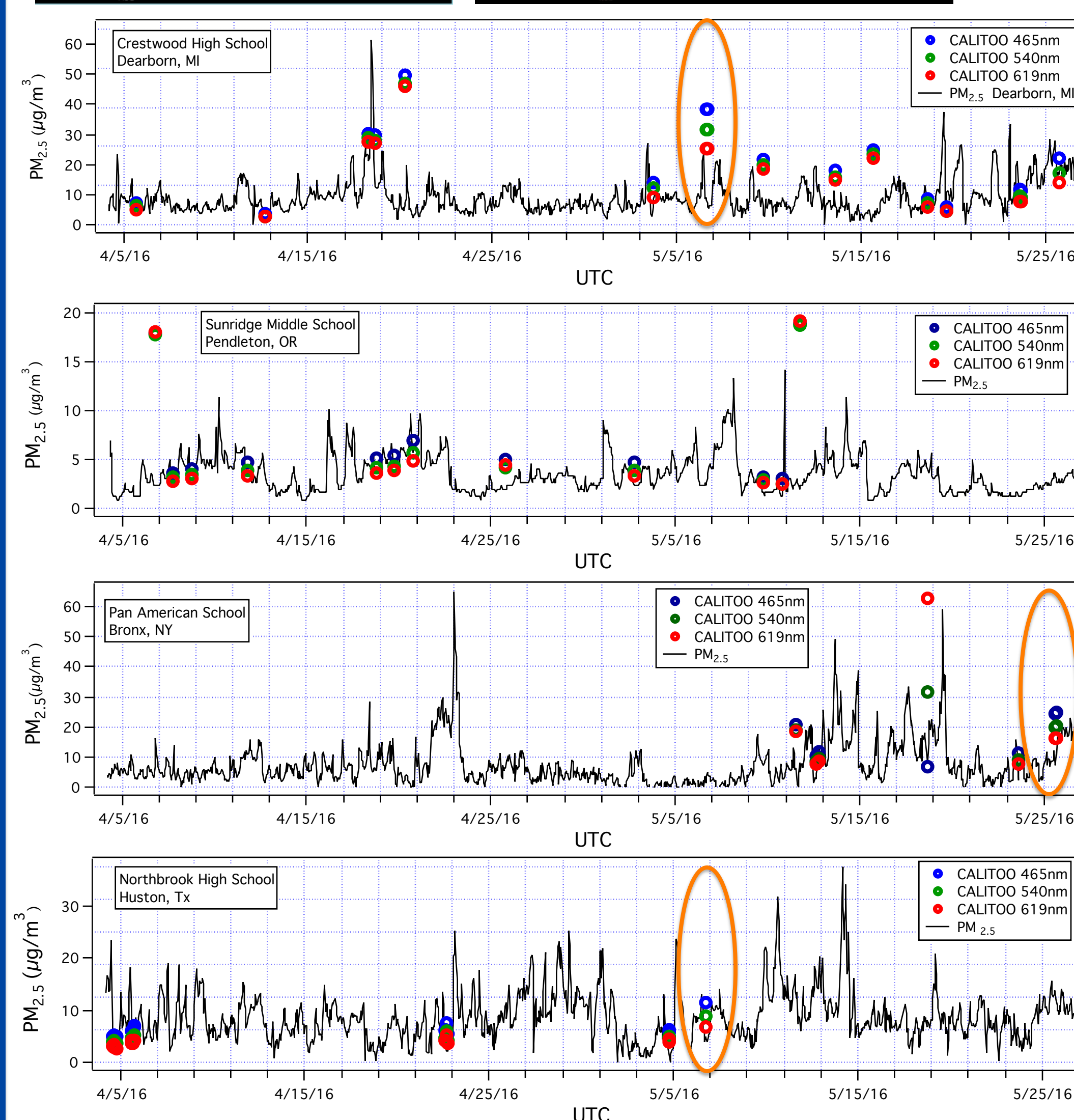
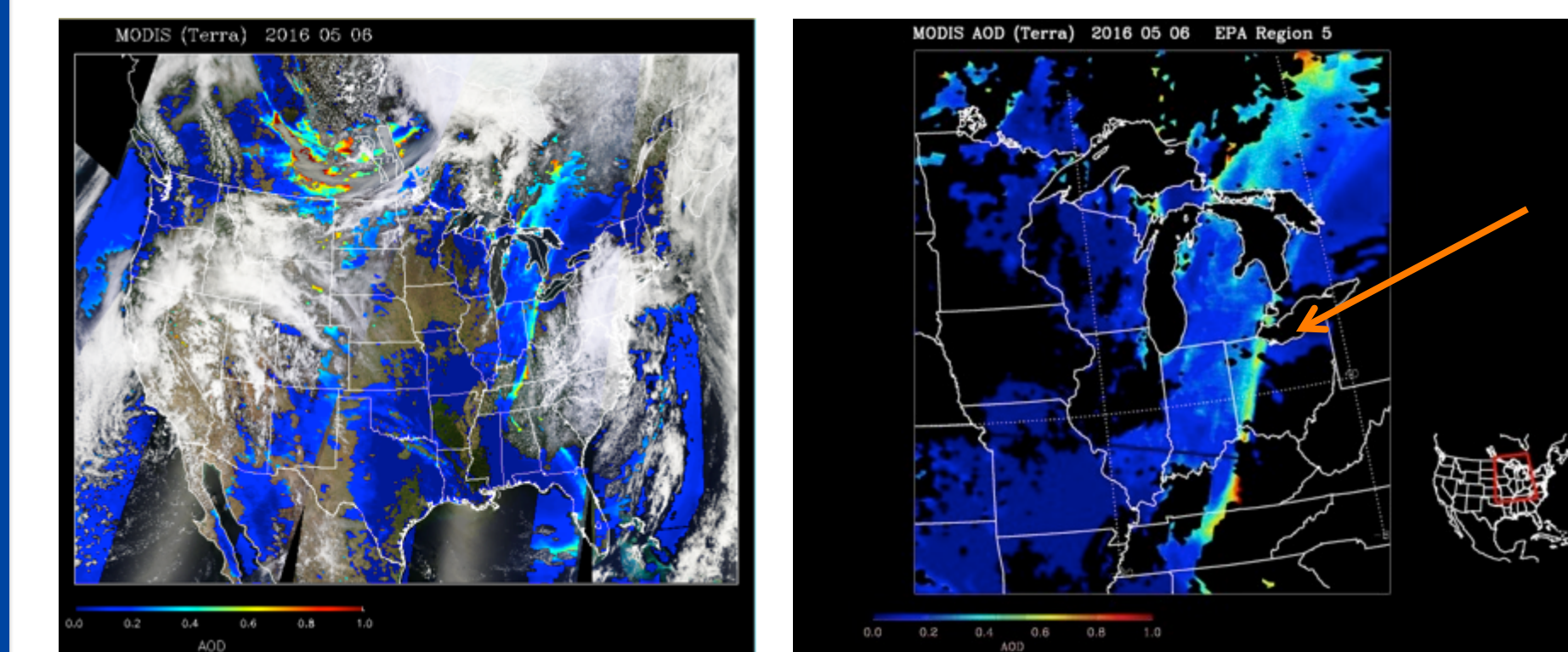
## Data Analysis

The participating schools experienced mostly cloudy skies throughout the Campaign resulting in sparse data collection. However the Alberta Canada fire, which started May 1, impacted all the participating schools during the month of May and can be seen in the data. Often schools have a single or a few data points in the same day among many days of no observations, so its difficult to gain an understanding of the value of the data without seeing it in the larger context.

Smoke Map, May 6<sup>th</sup> and 7<sup>th</sup> 2016

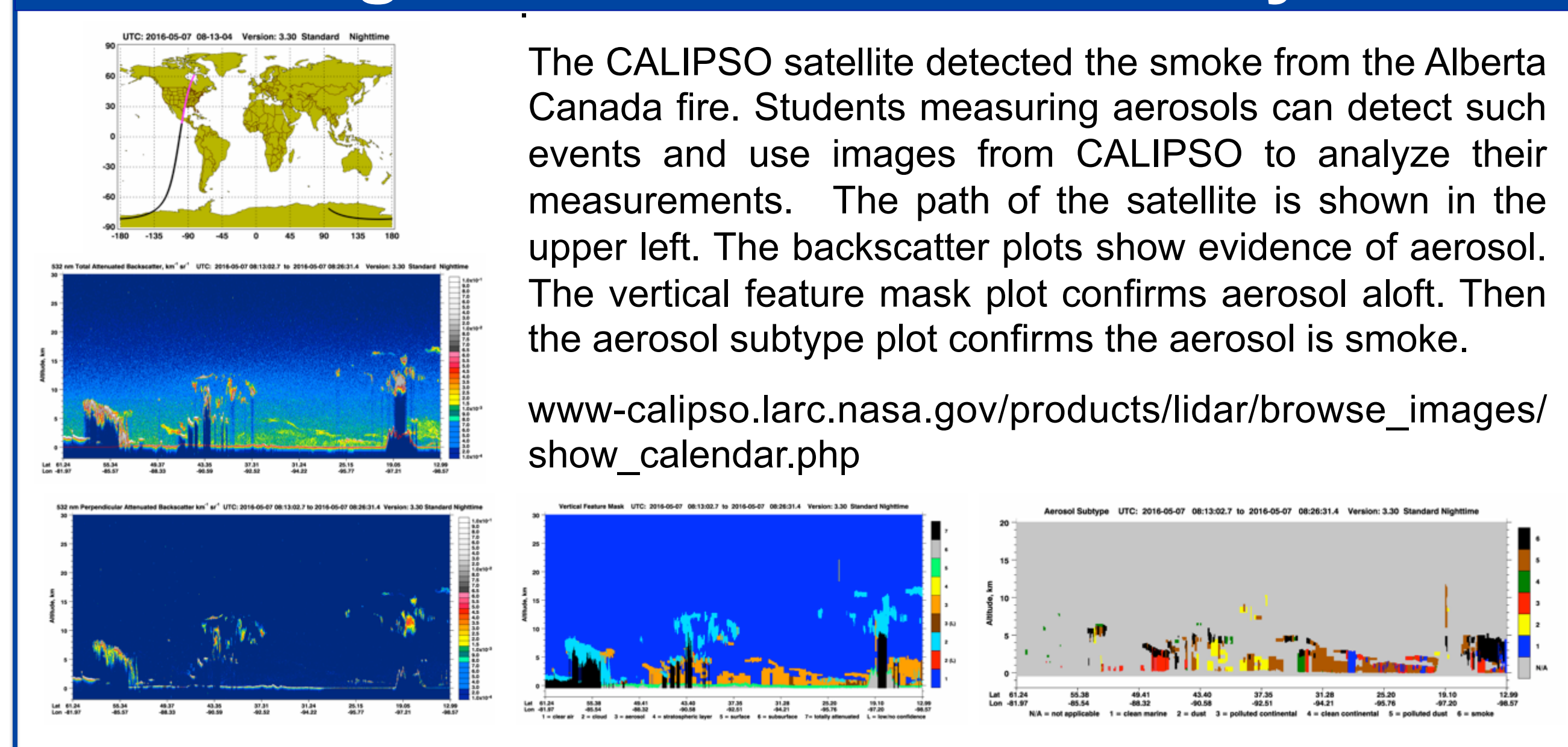


The MODIS maps to the left show elevated AOT in the Dearborn, MI area on May 6, 2016. The Crestwood High School in MI and Northbrook High School in TX Calitoo AOT data capture the smoke on this day. The separation in the AOT values for the three wavelengths indicates smaller particles. The PM<sub>2.5</sub> is elevated which could indicate smoke reaching the surface.



By examining AOT from satellites and surface AERONET sites and incorporating PM<sub>2.5</sub> measurements, it is easier to see how the student observations capture the fire event. The GLOBE photometers measure AOT in the column of air above the student, 'looking up', while AOT can be derived from satellites 'looking down' over large areas. However neither of these measurements tells anything about the vertical distribution of the measured aerosol. At the surface, where we breath, the PM<sub>2.5</sub> (particulate with sizes 2.5 microns or less) is measured. From the CALIPSO satellite, the vertical distribution of aerosol is derived but for narrow paths. So by combining all these measurements it becomes clear what is really happening. All the satellite, smoke map and PM data are easily accessible to students to use in their own analysis. A good resource is the IDEA website located at <http://www.star.nesdis.noaa.gov/smcd/spb/aq/>.

## Using CALIPSO for Data Analysis

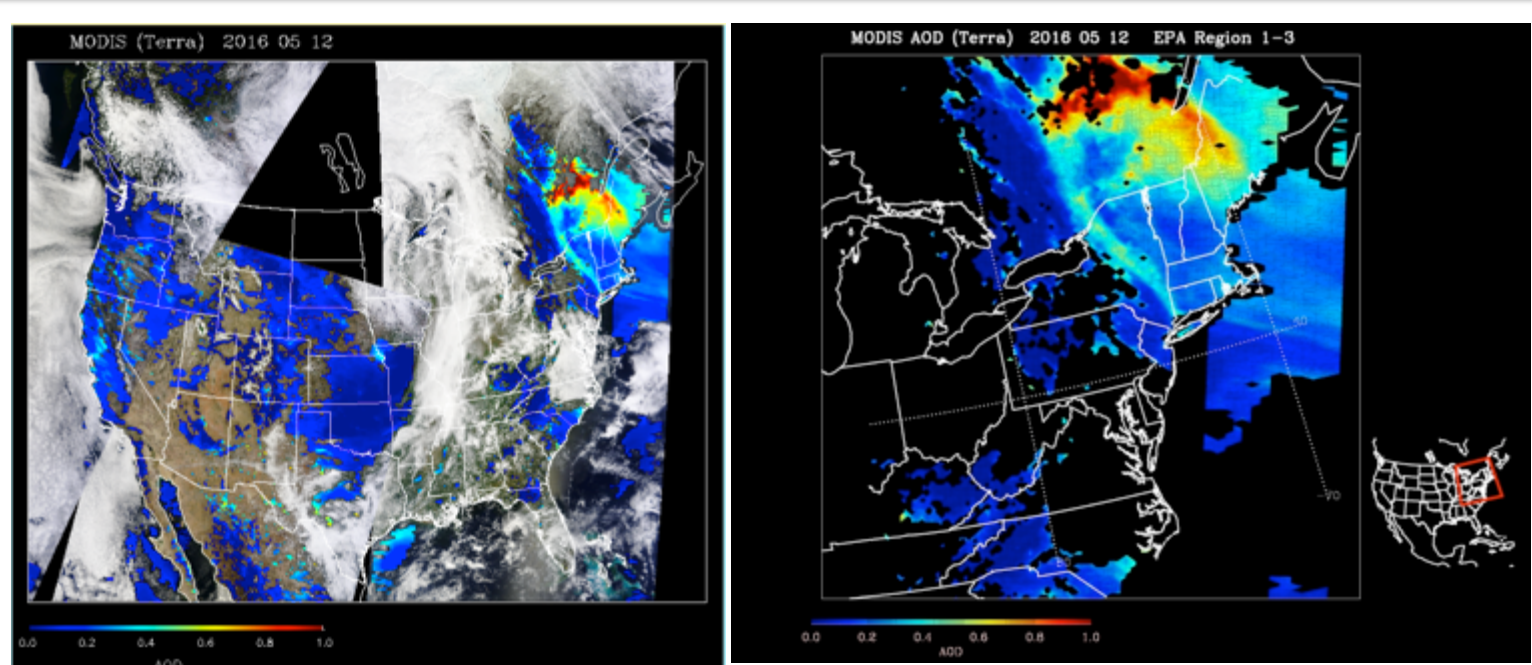
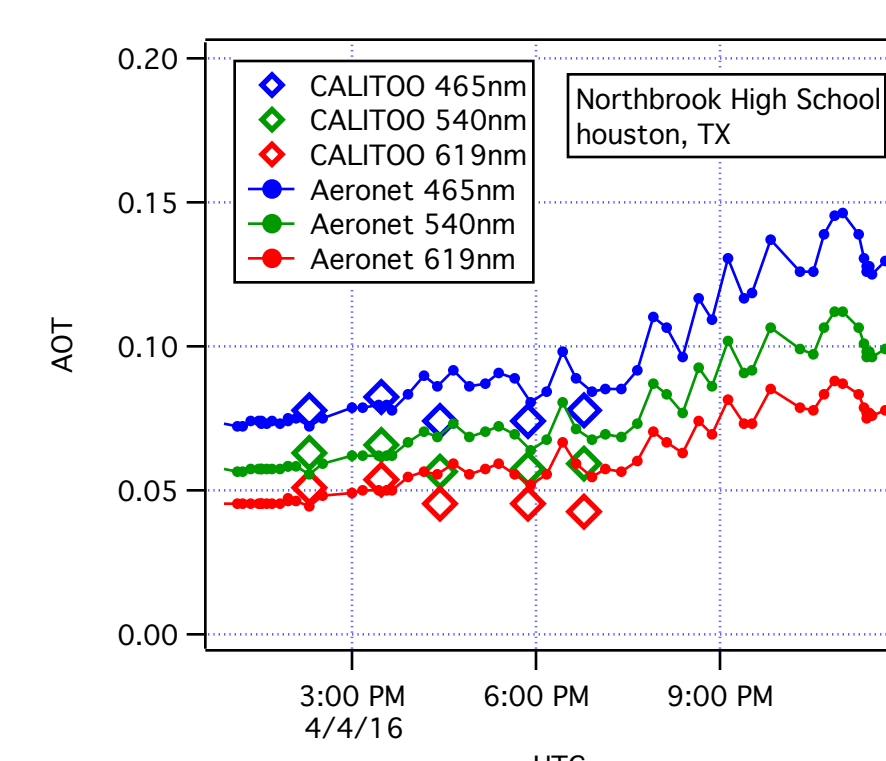


The CALIPSO satellite detected the smoke from the Alberta Canada fire. Students measuring aerosols can detect such events and use images from CALIPSO to analyze their measurements. The path of the satellite is shown in the upper left. The backscatter plots show evidence of aerosol. The vertical feature mask plot confirms aerosol aloft. Then the aerosol subtype plot confirms the aerosol is smoke.

[www-calipso.larc.nasa.gov/products/lidar/browse\\_images/show\\_calendar.php](http://www-calipso.larc.nasa.gov/products/lidar/browse_images/show_calendar.php)

On May 12, 2016 an elevated AOT can be seen in the MODIS plots to the right. This was also captured by the students at Pan American High School shown to the left.

Students at Northbrook High School measured AOT throughout a single day. Their measurements compare well with AERONET as shown below.



## Future Opportunities

If you are interested in participating in the 2016 Fall Aerosol Campaign please contact Dr. Margaret Pippin at [m.pippin@nasa.gov](mailto:m.pippin@nasa.gov) or Jessica Taylor at [jessica.e.taylor@nasa.gov](mailto:jessica.e.taylor@nasa.gov). Chris Marentette and Robert Bujosa participated in LEARN (Long Term Engagement with Authentic Research at NASA) for two years. Both of the teachers participated in the 2016 Spring Aerosol Campaign and in the analysis of the data or this poster during their Summer 2016 Teacher Internship at NASA.